Presenting Author: Yuxiao Ding

Co-Authors: Büşra Gamze Arslan, Robert Drost, Ziying Wang, Peter Liljeroth Department of Applied Physics, Aalto University School of Science, P.O. Box 15100, 00076 Aalto, Finland yuxiao.ding@aalto.fi

Abstract

Existence of quantum spin liquid (QSL) in a triangular lattice 1T-TaSe₂ is a topic of debate in condensed matter physics and two-dimensional materials community (ref 1, ref 2). 1T-TaSe₂ exbibits a charge density wave (CDW) state at low temperature where each CDW site hosts one localized unpaired spin (ref 3). This material presents a text-book model to study frustrated magnetism. In this study, we synthesised monolayer 1T-TaSe₂ on highly ordered pyrolytic graphite (HOPG) substrates using molecular beam epitaxy (MBE) and studied the magnetic excitations using scanning tunnelling microscopy (STM). The 1T-TaSe₂ CDW lattice displays a $\sqrt{3}$ reconstruction. We use inelastic tunnelling spectroscopy to detect low-energy magnetic excitations arising from the possible underlying quantum spin liquid ground state. We further carried out spatially dependent inelastic tunnelling spectroscopy to probe the $\sqrt{3}$ reconstruction of the magnetic excitations. Our work presents first steps towards experimental study of magnetically reconstructed quantum spin liquids in two-dimensional materials.

References

- [1] Mañas-Valero, S., Huddart, B.M., Lancaster, T. et al. Quantum phases and spin liquid properties of 1T-TaSe₂. npj Quantum Mater. 6, 69 (2021).
- [2] K.T. Law, & P.A. Lee, 1T-TaSe₂ as a quantum spin liquid, Proc. Natl. Acad. Sci. U.S.A. 114 (27) 6996-7000 (2017).
- [3] Ruan, W., Chen, Y., Tang, S. et al. Evidence for quantum spin liquid behaviour in singlelayer 1T-TaSe₂ from scanning tunnelling microscopy. Nat. Phys. 17, 1154–1161 (2021).

Figures



Figure 1: (Left) Inelastic tunnelling spectroscopy at low energy. (Right) Moiré reconstruction pattern on 1T-TaSe₂.